WHAT IS CLAIMED IS:

1. A method for manufacturing an optical transmission device comprising steps of:

mixing a first photosetting resin comprising a first photopolymerization initiator and a first monomer or oligomer to be polymerized in a first polymerization type by said first photopolymerization initiator, and a second photosetting resin comprising a second photopolymerization initiator and a second monomer or oligomer to be polymerized in a second polymerization type that is different from said first polymerization type by said second photopolymerization initiator;

forming a core portion of the optical transmission device by hardening said first photosetting resin by making a first irradiation that activates said first photopolymerization initiator but does not activate said second photopolymerization initiator; and

forming a clad portion of the optical transmission device by hardening both said first photosetting resin and said second photosetting resin by making a second irradiation that activates both said first and second photopolymerization initiators;

wherein said first irradiation has a wavelength shorter than the longest wavelength required to activate said first photopolymerization and longer than the longest wavelength

required to activate said second photopolymerization.

2. A method for manufacturing an optical transmission device according to claim 1, wherein one of said first polymerization type and said second polymerization type is radical polymerization, and the other is cationic polymerization.

3. A method for manufacturing an optical transmission device according to claim 1, wherein, when said core portion of a length L (unit of cm) is formed in a time s (unit of second) employing a light with a wavelength λ_w and an intensity of illumination I_0 (unit of mW/cm^2), an optical loss α (unit of dB/cm) of said first photosetting resin before being hardened and a minimum amount of exposure $\sigma_A(\lambda_w)$ (unit of mJ/cm^2) for hardening at the wavelength λ_w satisfy the following expression:

$$\alpha \leq \frac{10}{L} \log_{10} \frac{I_0 \cdot s}{\sigma_A(\lambda_W)}.$$

4. A method for manufacturing an optical transmission device according to claim 1, wherein said first photopolymerization initiator is activated through two photon absorption.

5. A method for manufacturing an optical transmission device according to claim 1, further comprising steps of:

making said first irradiation by applying a light flux of a minute diameter into a mixed resin of said first photosetting resin and said second photosetting resin to thereby grow said core portion with a substantially constant diameter so as to extend in a passing direction of the light flux; and

disposing a low refractive index structure to surround a designed terminal area of the light flux to allow said core portion to reach said designed terminal area, whereby if said light flux gets rid of said designed terminal area, said light flux is refracted due to total reflection on said low refractive index structure to reach said designed terminal area, thereby growing said core portion to reach said designed terminal area.

6. A method for manufacturing an optical transmission device according to claim 5, wherein said designed terminal area is a circular area, and said low refractive index structure forms an inner wall on a side face of a truncated cone with said circular area as an upper face.

7. A method for manufacturing an optical transmission device according to claim 6, wherein said designed

terminal area is a circle of radius a, and said core portion is designed to rectilinearly advance at least from a position distance b off a center of said circle of radius a and orthogonal to said designed terminal area, wherein an inclination angle θ_m of the side wall of said truncated cone satisfies the following expression, assuming that a height of said truncated cone is L_m, a refractive index of said core portion with the substantially constant diameter is n_1, and a refractive index of said low refractive index structure is n_m,

$$0 < \theta_m \leq \tan^{-1} \frac{\sqrt{(b+at)^2 - 4(a-bt+L_m t)L_m t} - b - at}{2L_m t}$$

$$t = \tan\theta_{max} = \tan\left(\cos^{-1}\frac{n_m}{n_1}\right).$$

8. A method for manufacturing an optical transmission device according to claim 5, wherein said low refractive index structure forms a part of a spheroid with a major axis as a rotation axis, said designed terminal area contains one focal point of an elliptic section with the rotation axis of said spheroid as a major axis, in which said core portion is designed to advance rectilinearly at least from the other focal point.

9. A method for manufacturing an optical

transmission device according to claim 8, wherein axes of coordinates are taken in a space, and said designed terminal area is like a disk of radius a centered at a point (0, b/2, 0) and perpendicular to y axis, in which said core portion is designed to advance rectilinearly at least from a position of a point (0, -b/2, 0), and assuming that a refractive index of said core portion is n_1, a refractive index of said low refractive index structure is n_m, said spheroid is made by rotating a following ellipse with the y axis as a major axis around the y axis as the rotation axis,

$$\frac{x^2}{a_0^2}+\frac{y^2}{b_0^2}=1 \quad , \quad z=0$$

$$a_0^2=\frac{a^2+a\sqrt{a^2+b^2}}{2}$$

$$b_0=\frac{a+\sqrt{a^2+b^2}}{2}$$

and the following expression holds at a point on said ellipse of said low refractive index structure,

$$\cos\left\{\tan^{-1}\frac{y+\frac{b}{2}}{x}-\tan^{-1}\left(-\frac{b_0^2}{a_0^2}\frac{x}{y}\right)\right\}\leq\frac{n_m}{n_1} .$$

10. A method for manufacturing an optical

transmission device according to claim 1, further comprising steps of:

making said first irradiation by applying a light flux of a minute diameter into a mixed resin of said first photosetting resin and said second photosetting resin to thereby grow said core portion with a substantially constant diameter so as to extend in a passing direction of the light flux; and

disposing a reflective structure to surround a designed terminal area of the light flux to allow said core portion to reach said designed terminal area, whereby if said light flux gets rid of said designed terminal area, said light flux is refracted on said reflective structure to reach said designed terminal area, thereby growing said core portion to reach said designed terminal area.

11. A method for manufacturing an optical transmission device according to claim 10, wherein said terminal area is a circular area, and said reflective structure forms an inner wall on a side face of a truncated cone with said circular area as an upper face.

12. A method for manufacturing an optical transmission device according to claim 11, wherein said designed terminal area is a circle of radius a, and said core

portion is designed to rectilinearly propagate at least from a position distance b off a center of said circle of radius a and perpendicular to said designed terminal area, in which an inclination angle θ_m of the side wall of said truncated cone satisfies the following expression, assuming that a height of said truncated cone is L_m,

$$0 < \theta_m \leq \tan^{-1}\left\{\frac{1}{3L_m b}\left(\sqrt[3]{\frac{s_6}{2}} - as_3 - \sqrt[3]{\frac{2}{s_6}}\, s_2\right)\right\}$$

$$s_1 = -16a^3b^3 + 72ab^3L_m^{\ 2} - 54a^3L_m^{\ 3} - 54ab^2L_m^{\ 3}$$
$$s_2 = -4a^2b^2 - 9a^2L_m^{\ 2} + 3b^2L_m^{\ 2}$$
$$s_3 = 2b + 3L_m$$
$$s_4 = 2b - 3L_m$$
$$s_5 = 27ab^2L_m^{\ 2}s_4 - 2a^3s_3^{\ 3} + 9abL_m s_3\left(4a^2 + bL_m\right)$$
$$s_6 = s_1 + \sqrt{4s_2^{\ 3} + s_5^{\ 2}} \quad .$$

13. A method for manufacturing an optical transmission device according to claim 10, wherein said reflective structure forms a part of a spheroid with a major axis as a rotation axis, and said terminal area contains one focal point of an elliptic section with the rotation axis of said spheroid as a major axis, in which said self-forming optical transmission device is designed to advance rectilinearly at least from that the other focal point.

14. A method for manufacturing an optical transmission device according to claim 13, wherein axes of coordinates are taken in a space, and said designed terminal area is like a disk with a radius a centered at a point (0, b/2, 0) and perpendicular to the y axis, in which said clad portion is designed to advance rectilinearly from a position of a point (0, -b/2, 0), and said spheroid is made by rotating a following ellipse with the y axis as a major axis around the y axis as the rotation axis,

$$\frac{x^2}{a_0^2} + \frac{y^2}{b_0^2} = 1 \quad , \quad z = 0$$

$$a_0^2 = \frac{a^2 + a\sqrt{a^2 + b^2}}{2}$$

$$b_0 = \frac{a + \sqrt{a^2 + b^2}}{2}$$

15. A method for manufacturing an optical transmission device comprising steps of:

mixing a first photosetting resin comprising a first photopolymerization initiator and a first monomer or oligomer to be polymerized in a first polymerization type by said first photopolymerization initiator, and a second photosetting resin comprising a second photopolymerization initiator and

a second monomer or oligomer to be polymerized in a second polymerization type that is different from said first polymerization type by said second photopolymerization initiator;

forming a core portion of the optical transmission device by hardening said first photosetting resin by making a first irradiation that activates said first photopolymerization initiator but does not activate said second photopolymerization initiator; and

forming a clad portion of the optical transmission device by hardening both said first photosetting resin and said second photosetting resin by making a second irradiation that activates both said first and second photopolymerization initiators;

wherein said first irradiation has an amount of exposure more than the minimum amount of exposure required to harden said first photosetting resin substantially completely and smaller than the maximum amount of exposure not to harden said second photosetting resin completely.

16. A method for manufacturing an optical transmission device according to claim 15, wherein one of said first polymerization type and said second polymerization type is radical polymerization, and the other is cationic polymerization.

17. A method for manufacturing an optical transmission device according to claim 15, wherein, when said core portion of a length L (unit of cm) is formed in a time s (unit of second) employing a light with a wavelength λ_w and an intensity of illumination I_0 (unit of mW/cm^2), an optical loss α (unit of dB/cm) of said first photosetting resin before being hardened and a minimum amount of exposure $\sigma_A(\lambda_w)$ (unit of mJ/cm^2) for hardening at the wavelength λ_w satisfy the following expression:

$$\alpha \leqq \frac{10}{L} \log_{10} \frac{I_0 \cdot s}{\sigma_A(\lambda_W)}.$$

18. A method for manufacturing an optical transmission device according to claim 15, wherein said first photopolymerization initiator is activated through two photon absorption.

19. A method for manufacturing an optical transmission device according to claim 15, further comprising steps of:

making said first irradiation by applying a light flux of a minute diameter into a mixed resin of said first photosetting resin and said second photosetting resin to

thereby grow said core portion with a substantially constant diameter so as to extend in a passing direction of the light flux; and

disposing a low refractive index structure to surround a designed terminal area of the light flux to allow said core portion to reach said designed terminal area, whereby if said light flux gets rid of said designed terminal area, said light flux is refracted due to total reflection on said low refractive index structure to reach said designed terminal area, thereby growing said core portion to reach said designed terminal area.

20. A method for manufacturing an optical transmission device according to claim 19, wherein said designed terminal area is a circular area, and said low refractive index structure forms an inner wall on a side face of a truncated cone with said circular area as an upper face.

21. A method for manufacturing an optical transmission device according to claim 20, wherein said designed terminal area is a circle of radius a, and said core portion is designed to rectilinearly advance at least from a position distance b off a center of said circle of radius a and orthogonal to said designed terminal area, wherein an inclination angle θ_m of the side wall of said truncated cone satisfies the following expression, assuming that a height

of said truncated cone is L_m, a refractive index of said core portion with the substantially constant diameter is n_1, and a refractive index of said low refractive index structure is n_m,

$$0 < \theta_m \leq \tan^{-1}\frac{\sqrt{(b+at)^2 - 4(a - bt + L_m t)L_m t} - b - at}{2L_m t}$$

$$t = \tan\theta_{max} = \tan\left(\cos^{-1}\frac{n_m}{n_1}\right).$$

22. A method for manufacturing an optical transmission device according to claim 19, wherein said low refractive index structure forms a part of a spheroid with a major axis as a rotation axis, said designed terminal area contains one focal point of an elliptic section with the rotation axis of said spheroid as a major axis, in which said core portion is designed to advance rectilinearly at least from the other focal point.

23. A method for manufacturing an optical transmission device according to claim 22, wherein axes of coordinates are taken in a space, and said designed terminal area is like a disk of radius a centered at a point (0, b/2, 0) and perpendicular to y axis, in which said core portion is designed to advance rectilinearly at least from a position

of a point (0, -b/2, 0), and assuming that a refractive index of said core portion is n_1, a refractive index of said low refractive index structure is n_m, said spheroid is made by rotating a following ellipse with the y axis as a major axis around the y axis as the rotation axis,

$$\frac{x^2}{a_0^2}+\frac{y^2}{b_0^2}=1 \quad , \quad z=0$$

$$a_0^2=\frac{a^2+a\sqrt{a^2+b^2}}{2}$$

$$b_0=\frac{a+\sqrt{a^2+b^2}}{2}$$

and the following expression holds at a point on said ellipse of said low refractive index structure,

$$\cos\left\{\tan^{-1}\frac{y+\frac{b}{2}}{x}-\tan^{-1}\left(-\frac{b_0^2}{a_0^2}\frac{x}{y}\right)\right\}\leqq\frac{n_m}{n_1}.$$

24. A method for manufacturing an optical transmission device according to claim 15, further comprising steps of:

making said first irradiation by applying a light flux of a minute diameter into a mixed resin of said first photosetting resin and said second photosetting resin to

thereby grow said core portion with a substantially constant diameter so as to extend in a passing direction of the light flux; and

disposing a reflective structure to surround a designed terminal area of the light flux to allow said core portion to reach said designed terminal area, whereby if said light flux gets rid of said designed terminal area; said light flux is refracted on said reflective structure to reach said designed terminal area, thereby growing said core portion to reach said designed terminal area.

25. A method for manufacturing an optical transmission device according to claim 24, wherein said terminal area is a circular area, and said reflective structure forms an inner wall on a side face of a truncated cone with said circular area as an upper face.

26. A method for manufacturing an optical transmission device according to claim 25, wherein said designed terminal area is a circle of radius a, and said core portion is designed to rectilinearly propagate at least from a position distance b off a center of said circle of radius a and perpendicular to said designed terminal area, in which an inclination angle θ_m of the side wall of said truncated cone satisfies the following expression, assuming that a height

of said truncated cone is L_m,

$$0 < \theta_m \leq \tan^{-1}\left\{\frac{1}{3L_m b}\left(\sqrt[3]{\frac{s_6}{2}} - as_3 - \sqrt[3]{\frac{2}{s_6}}s_2\right)\right\}$$

$$s_1 = -16a^3b^3 + 72ab^3L_m^{\ 2} - 54a^3L_m^{\ 3} - 54ab^2L_m^{\ 3}$$
$$s_2 = -4a^2b^2 - 9a^2L_m^{\ 2} + 3b^2L_m^{\ 2}$$
$$s_3 = 2b + 3L_m$$
$$s_4 = 2b - 3L_m$$
$$s_5 = 27ab^2L_m^{\ 2}s_4 - 2a^3s_3^{\ 3} + 9abL_m s_3\left(4a^2 + bL_m\right)$$
$$s_6 = s_1 + \sqrt{4s_2^{\ 3} + s_5^{\ 2}}\ .$$

27. A method for manufacturing an optical transmission device according to claim 24, wherein said reflective structure forms a part of a spheroid with a major axis as a rotation axis, and said terminal area contains one focal point of an elliptic section with the rotation axis of said spheroid as a major axis, in which said self-forming optical transmission device is designed to advance rectilinearly at least from that the other focal point.

28. A method for manufacturing an optical transmission device according to claim 27, wherein axes of coordinates are taken in a space, and said designed terminal area is like a disk with a radius a centered at a point (0,

b/2, 0) and perpendicular to the y axis, in which said clad portion is designed to advance rectilinearly from a position of a point (0, -b/2, 0), and said spheroid is made by rotating a following ellipse with the y axis as a major axis around the y axis as the rotation axis,

$$\frac{x^2}{a_0^2} + \frac{y^2}{b_0^2} = 1 \quad , \quad z = 0$$

$$a_0^2 = \frac{a^2 + a\sqrt{a^2 + b^2}}{2}$$

$$b_0 = \frac{a + \sqrt{a^2 + b^2}}{2}$$

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29. An optical transmission and reception module comprising:

electrical signal input/output means for inputting or outputting a first electrical signal and a second electrical signal relevant with said first electrical signal from or to the outside;

conversion means for converting said first electrical signal and said second electrical signal into a first optical signal and a second optical signal, respectively, and inversely converting said first optical signal and said second optical signal into said first electrical signal and said second electrical signal, respectively;

first optical signal input/output means for inputting or outputting said first optical signal from or to an optical transmission medium; and

second optical signal input/output means for inputting or outputting said second optical signal from or to the same optical transmission medium as said first optical signal at a different wavelength from said first optical signal.

30. A optical transmission and reception module according to claim 29, wherein said second optical signal input/output means comprises synthesis and separation means for synthesizing two optical signals having different wavelengths that are output from said first optical signal input/output means and said second optical input/output means to input a synthesized signal into said optical transmission medium, and separating said two optical signals having different wavelengths transmitted through said optical transmission medium.

31. A optical transmission and reception module according to claim 29, further comprising guide and separation means for guiding an optical signal for input into said optical transmission medium to said optical transmission medium, and separating an optical signal for output from said optical transmission medium, said guide and separation means being

provided on at least one of said first optical signal input/output means and said second optical signal input/output means.

32. An optical transmission and reception module according to claim 29, wherein said electrical signal conforms to the IEEE1394 standard.

33. An optical transmission and reception module according to claim 29, further comprising connection means for connecting said optical signal to said optical transmission medium so that said optical signal can be input or output from or to said optical transmission medium.

34. A communication device comprising a combination of said optical transmission medium and at least two said optical transmission and reception modules according to claim 29 provided at both ends of said optical transmission medium.

35. A method for forming an optical transmission device within an optical transmission and reception module for transmitting and receiving an optical signal, said optical transmission and reception module having internally a light emitting element for emitting a light beam for communication with a predetermined wavelength and a light receiving element

for receiving the light beam, said method comprising steps of;

introducing a light beam of a predetermined wavelength for formation of the optical transmission device into a space area for forming said optical transmission device within said optical transmission and reception module to fill a photosetting resin solution that is hardened in an optical axis direction;

inserting one end of an optical fiber through a light input/output opening of said optical transmission and reception module;

outputting said light beam of predetermined wavelength for communication by emitting light from said light emitting element;

detecting a quantity of output light output to the outside of said transmission and reception module via said optical fiber among said light beam of predetermined wavelength for communication that is output;

adjusting a light input/output axis direction of said optical fiber such that said quantity of output light is substantially at maximum; and

entering the light beam of predetermined wavelength for formation of said optical transmission device from the other end of said optical fiber into said optical transmission and reception module, while maintaining the adjusted light

input/output axis direction of said optical fiber.

36. A method for forming the optical transmission device according to claim 35, wherein said photosetting resin solution is a mixture solution of a first photosetting resin solution having a longer setting start wavelength than said predetermined wavelength and a second photosetting resin solution having a shorter setting start wavelength than said predetermined wavelength, wherein an axial core portion is formed by hardening only said first photosetting resin solution with the light beam of predetermined wavelength from said light source, and then a clad portion having a smaller refractive index than that of said core portion is formed around said core portion by applying light in a wavelength band for hardening said first and second photosetting resin solutions from around said mixture solution.

37. A method for forming the optical transmission device according to claim 35, wherein the optical transmission device is produced in a state where one end of said optical fiber is immersed in said photosetting resin solution.